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Stylesheet Version v1.1.1

Description

MIRROR SYSTEM WITH INTERLOCK ATTACHMENT FOR REFLECTIVE ELEMENT

Cross Reference to Related Applications

[0001] This application claims the benefit of U.S. provisional application Serial No. 60/319,688, filed November 12, 2002, which is incorporated herein in its entirety.

Background of Invention

Field of the Invention

[0002] The invention relates to a motor vehicle mirror and, more particularly, to a motor vehicle mirror having a reflective element mounted to a tilt actuator through an interlocking panel assembly.

Description of the Related Art

[0003] Rear view mirrors, specifically external mirrors, are ubiquitous for contemporary motor vehicles and have long been used to aid the driver in operating the vehicle, especially in improving the rearward view of the driver. A tilt

actuator to adjust the mirror's field of view is fixedly mounted to a rigid frame within the mirror assembly housing, and is operably connected to a reflective element assembly.

[0004] The reflective element assembly typically comprises multiple pieces (and multiple layers) comprising a mounting panel or "glass case" to which a reflective element, i.e. the mirror, is attached. The reflective element is fixedly attached to the glass case with an adhesive or a mechanical hold-down assembly. The reflective element typically comprises a piece of glass with a reflective coating on one side, similar to a conventional household mirror. A glass or rigid, impact-resistant clear plastic plate may be attached to the mirror housing to enclose the reflective element and protect it from impact or the weather. A bezel may also be placed over the reflective element to secure the reflective element to the mounting panel, add further protection to the reflective element and/or people adjacent to the vehicle, and improve the appearance of the reflective element.

[0005] The various components making up the reflective element can be relatively heavy, particularly where several pieces of glass are used. In particular, mirrors used for trucks,

SUVs, and other large vehicles can be quite large and heavy. Heavier mirrors require stronger supporting and mounting components and more robust adjustment actuators, and can contribute to a reduction in the mileage of the vehicle due to the weight of the mirror. Fasteners, such as threaded, snap-fit, and rivet-type fasteners, require complementary fastening structures that add weight and fabrication complexity to the mirror assembly. Thus, weight reduction through the use of plastic or other lightweight components, and simplified fastening devices, are highly desirable.

[0006] The use of a plastic mounting panel, however, can give rise to structural imperfections such as "read-through" and waviness which can, in turn, introduce unacceptable optical imperfections in the reflective element. "Read-through" refers to the ability to see underlying geometry on an outer opaque surface due to localized shrink and deformation. This localized shrink and deformation occurs more readily in relatively thick sections of the material. If the reflective element is a film, this "read-through" image can be seen in the film, distorting the reflection image. Similarly, deviations from a plane surface, or "waviness," in the plastic mounting panel can give rise to a non-

planar reflective surface, particularly where a reflective film is used, thereby distorting the reflection image. Furthermore, structural elements, such as those required for threaded, snap-fit, and rivet-type fasteners, can give rise to "read through."

SUMMARY OF INVENTION

[0007] A mirror assembly for a motor vehicle comprises a reflective element assembly comprising a reflective surface for providing a reflection image, and a reflective surface mounting panel for mounting the reflective surface thereto, a mounting frame for mounting the reflective element assembly to the motor vehicle, and an interlocking fastener assembly for removably attaching a first one of the reflective element assembly to the mounting frame, comprising a first array of interlocking fasteners attached to the mounting frame and a second array of interlocking fasteners attached to the first one of the reflective element assembly and configured to interlock with the first array.

[0008] The mounting panel can comprise a lightweight material, such as a synthetic resin, a thermoplastic, or a gas-injected plastic having a plurality of microscopic voids distributed throughout. The reflective surface can com-

prise a polymeric reflective film conformably attached to the mounting panel to provide a reflection image therein, wherein the reflection image is essentially free of visible distortion.

[0009] The mounting frame can further comprise a tilt actuator for selectively vertically and horizontally tilting the reflective element assembly in order to adjust a rearward field of vision provided thereby. The tilt actuator can further comprise a mounting plate pivotally attached thereto.

[0010] The first array can be attached to the mounting plate. A base plate can be attached to the mounting plate, wherein the first array is attached to the base plate. The second array can be attached to the mounting panel. A mirror plate can be attached to the mounting panel, wherein the second array is attached to the mirror plate. The first array and the second array can be attachable and detachable without the use of separate fasteners.

[0011] The first one of the reflective element assembly can be attached to the tilt actuator by pressing the first array and the second array together, and the first one of the reflective element assembly can be separated from the tilt actuator for replacement by a second one of the reflective element assembly by pulling the first array and the second

array apart. At least one of the first array and the second array can comprise a regularly-spaced plurality of fastening elements, each fastening element comprising an elongated cylindrical shaft terminating in an expanded, mushroom-shaped head.

[0012] In another embodiment, a motor vehicle comprises at least one mirror system for providing a rearward view to the operator of the motor vehicle, and the mirror system comprises a reflective element assembly comprising a reflective surface for providing a reflection image, and a mounting panel for mounting the reflective surface thereto, a mounting frame for mounting the reflective element assembly to the motor vehicle, and an interlocking fastener assembly for removably attaching a first one of the reflective element assembly to the mounting frame, comprising a first array of interlocking fasteners attached to the mounting frame and a second array of interlocking fasteners attached to the first one of the reflective element assembly and adapted for interlocking communication with the first array.

BRIEF DESCRIPTION OF DRAWINGS

[0013] In the drawings:

[0014] Figure 1 is a perspective view of a portion of a motor vehicle having an attached mirror system comprising a reflective element assembly and an interlocking fastener assembly according to the invention.

[0015] Figure 2 is an exploded rear view of the interior structure of a first embodiment of the mirror system of Figure 1.

[0016] Figure 3 is a front perspective view of the interior structure of the mirror system of Figure 1 with the reflective element removed for clarity.

[0017] Figure 4 is an exploded front view of the mirror system of Figure 1.

[0018] Figure 5 is a partial sectional view taken along line 5-5 of a portion of the mirror system of Figure 4 showing mating interlocking panels in position to be interlocked.

[0019] Figure 6 is a side view of the interlocking panels of Figure 5 in an interlocked configuration.

[0020] Figure 7 is a perspective view of the interior structure of the mirror system of Figure 1 showing the reflective element mounted to the interlocking panels.

[0021] Figure 8 is an exploded front view of the interior structure of a second embodiment of the mirror system of Figure 1.

DETAILED DESCRIPTION

[0022] As shown in Figure 1, an exterior motor vehicle mirror

system 10 according to the invention is mounted in a conventional fashion to a motor vehicle 12. The mirror system 10 comprises a casing 14 enclosing a reflective element assembly 16. Referring also to Figures 2, 4, and 7, in a first embodiment of the invention, a mounting bracket 18 is fixedly mounted within the casing 14 and supports a tilt actuator 20 for vertical and horizontal tilting of the reflective element assembly 16 in order to adjust the rearward field of vision provided thereby. The reflective element assembly 16 is operably connected to the tilt actuator 20 through a circular mounting plate 22 and a tool-less interlocking fastener assembly 30. The reflective element assembly 16 is attached to the interlocking fastener assembly 30 as hereinafter described.

[0023] The circular mounting plate 22 is a plate-like body adapted for operable register with the tilt actuator 20 so that the mounting plate 22 will tilt about a vertical axis or a horizontal axis with the operation of the tilt actuator 20 in a manner well-known in the art.

[0024] As shown also in Figure 5, the interlocking fastener assembly 30 comprises a base plate 32 and a mirror plate 34. The base plate 32 comprises a panel-like body having a reverse side comprising a planar mounting face 26 in

opposed, parallel juxtaposition with an obverse side comprising a attachment stem surface 40. The mirror plate 34 comprises a panel-like body having a reverse side comprising a planar mounting face 60 in opposed, parallel juxtaposition with an obverse side comprising a attachment stem surface 50. The mounting faces 26, 60 are adapted for mating communication as hereinafter described.

[0025] As shown in Figure 4, the mounting plate 22 is provided with a pair of diagonally-opposed, cylindrical mounting posts 24 extending orthogonally from the mounting plate 22 in generally parallel juxtaposition. The base plate 32 is provided with a pair of base plate post apertures 36 in spaced-apart juxtaposition adapted for cooperative register with the cylindrical mounting posts 24. Similarly, the mirror plate 34 is provided with a pair of mirror plate post apertures 38 in spaced-apart juxtaposition adapted for cooperative register with the cylindrical mounting posts 24. The joining of the mounting plate 22, the base plate 32, and mirror plate 34, with the mounting posts 24 inserted through the aligned apertures 36, 38 will result in the proper relative orientation of the mounting plate 22, the base plate 32, and the mirror plate 34 during assem-

bly of the mirror system 10, and will minimize relative movement of the mounting plate 22, the base plate 32, and the mirror plate 34, thereby increasing the rigidity of the interlocking fastener assembly 30. Other positioning and strengthening elements can be used, such as mating ribs and channels, to ensure the proper orientation and relative rigidity of the assembled plates 22, 32, 34.

[0026] In a preferred embodiment, the interlocking fastener assembly 30 comprises an array of interlocking fasteners, such as the Dual Lock™ fastener system manufactured by 3M Company, Inc. Alternatively, the interlocking fastener assembly 30 can comprise other, readily-detachable fastener devices such as a hook and loop fastener system, also known as Velcro, or an array of interference fittings providing a snap-fit assembly. The advantage of such devices is the ability to assemble and disassemble components without the necessity of fastening tools or specialized disassembly tools.

[0027] Referring again to Figure 5, the base plate attachment stem surface 40 comprises a plurality of interlocking fastening elements, referred to herein as attachment stems 42, extending orthogonally therefrom in an ordered, regularly-spaced array. Each attachment stem 42 comprises a

generally cylindrical shaft 44 terminating in an expanded, mushroom-shaped head 46. Each assemblage of four adjoining attachment stems 42 defines an interstitial space 48. Similarly, the mirror plate attachment stem surface 50 comprises a plurality of interlocking fastening elements, referred to herein as attachment stems 52, extending orthogonally therefrom in an ordered, regularly-spaced array. Each attachment stem 52 comprises a generally cylindrical shaft 54 terminating in expanded, mushroom-shaped head 56. Each assemblage of four adjoining attachment stems 52 defines an interstitial space 58. The base plate attachment stem surface 40 is adapted for interlocking attachment to the mirror plate attachment stem surface 50, as hereinafter described.

[0028] The base plate 32 is fixedly attached to the circular mounting plate 22 through a suitable means of attachment, such as an adhesive or ultrasonic welding, so that the mounting posts 24 extend through the base plate post apertures 36, thereby ensuring the proper positioning and attachment of the base plate 32 to the circular mounting plate 22. Alternatively, the interlock mounting details 42-46 can be integrally formed onto the mounting plate 22 eliminating the need for a separately-attached

base plate 32. The mirror plate 34 is brought into cooperative register with the base plate 32, with the mounting posts 24 extending through the mirror plate post apertures 38, so that the heads 46 of the attachment stems 42 slide past the heads 56 of the attachment stems 52 to be received in the interstitial spaces 58, and the heads 56 of the attachment stems 52 are received in the interstitial spaces 48, thereby interlocking the base plate 32 and the mirror plate 34 to each other in proper orientation as shown in Figure 6. The base plate 32 can be readily separated from the mirror plate 34 by exerting a normal pulling force on the plates 32, 34 sufficient to slide the heads 46, 56 out of the interstitial spaces 48, 58 past each other.

[0029] Referring again to Figure 2, the reflective element assembly 16 comprises a planar reflective element mounting panel 62 having a reverse face 63, and a planar glass lens 66 having a reflective surface 64 in a generally conventional configuration well-known in the art. The reverse face 63 can optionally be provided with a mirror plate alignment outline 68 corresponding to the perimeter of the mirror plate 34 for proper alignment of the mirror plate 34 with the reflective element mounting panel 62.

The mirror plate alignment outline 68 comprises a rectilinear configuration of lines formed on or in the reverse face 63 through a suitable process such as etching, molding, or embossing.

[0030] As shown in Figures 2 and 7, the reflective element mounting panel 62 can be attached to the mirror plate 34 by a suitable means of attachment, such as an adhesive or ultrasonic welding, of the mounting surface 60 to the reverse face 63. Alternatively, the interlock mounting details 42-46 can be integrally formed onto the mounting panel 62 eliminating the need for a separately-attached mirror plate 34. The glass lens 66 with the reflective surface 64 can then be attached to the reflective element mounting panel 62 in a generally conventional manner to provide the tiltable reflective element assembly 16.

[0031] In an alternative embodiment, shown in Figure 8, the reflective element assembly 16 comprises a reflective film 72 applied to a reflective film mounting panel 70 similar to the reflective element mounting panel 62 or other suitable mounting plate. This results in a mirror assembly with fewer elements and less weight. The attachment of the reflective film mounting panel 70 to the tilt actuator 20 through the interlocking fastener assembly 30 remains

the same as for the first embodiment. Preferably, the reflective film 72 is a thin, flexible, polymer-based film having reflective properties, such as the multi-layer reflective film disclosed in U.S. Patent No. 6,352,761, issued March 5, 2002, and assigned to 3M Innovative Properties Co., St. Paul, Minnesota, which is incorporated herein by reference. The film is attached to the reflective film mounting panel 70 using a suitable process to avoid imperfections in the image provided by the reflective element assembly 16, and to conform the film to the surface of the reflective film mounting panel 70.

[0032] In this embodiment, the reflective film mounting panel 70 comprises a lightweight polymeric material capable of being fabricated with planar surfaces having minimal surface imperfections, such as "read-through" and waviness, which can manifest themselves as optical imperfections in the reflection image. A variety of synthetic resin materials, including thermoplastics, can be used to make the reflective film mounting panel 70. One such preferable material is that formed by the gas-injected MuCell technology owned by Trexel Inc. which virtually eliminates waviness and "read-through" effects while providing a virtually smooth, warp-free surface. A reduction in weight is

achieved with the use of the reflective film and the elimination of several of the elements contained in prior art multi-piece assemblies, particularly the glass elements. Further weight reductions are obtained by the use of the gas-injected technology (such as MuCell) which produces a glass case with a core having a generally uniform distribution of microscopic cells or voids (analogous to "bubbles"). The reflective film mounting panel 70, therefore, weighs less than if it were made from a solid polymeric member. It is contemplated that weight reductions of as much as an additional twenty percent of the overall weight of the glass case can be achieved. Furthermore, since the reflective film mounting panel 70 is a plate-like body comprising two parallel, planar surfaces having no section of varying thickness, "read through" and waviness are eliminated.

[0033] The reflective film 72 is attached to the reflective film mounting panel 70 through generally conventional laminating operations, with the film being stretched during the application process to ensure "optical acceptance" and an accurate reflection image, such as a 1% maximum distortion specification pursuant to Toyota Engineering Standard TSC3901G. For example, a clamp-frame can be used

on an injection mold which stretches the film 72 in two directions as is known in the art. Alternatively, the injection mold can be provided with a profile groove so that when the mold is closed, or when the plastic is injected, the film 72 is stretched.

[0034] The reflective film mounting panel 70 is attached to the mounting surface 60 of the mirror plate 34 through a suitable attachment means, such as an adhesive, thereby providing a reflective element assembly 16 having minimal distortion. The reflective film mounting panel 70 can be readily removed from the mirror system 10 in order to replace the reflective element assembly 16 by separating the mirror plate 34 from the reflective film mounting panel 70 as previously described. Thus, a lightweight mirror system 10 is provided having a high quality reflective surface which can be readily removed and replaced.

[0035] The mirror system with the interlocking panels is lightweight, but without the "read through" typically experienced with mirrors having plastic mounting panels, due to the use of the interlocking panels rather than conventional fasteners. The interlocking panels provide a secure attachment of the reflective element to the tilt actuator which can be readily assembled and disassembled

without the use of tools for replacement of the reflective element. The use of the interlocking panels and the elimination of conventional fasteners and their complementary structural components results in a lighter, more streamlined mirror system.

[0036] While the invention has been specifically described in connection with certain embodiments thereof, it is to be understood that this is by way of illustration and not of limitation. Reasonable variation and modification are possible within the scope of the forgoing description and drawings without departing from the spirit of the invention, which is described in the appended claims.